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Nyfea product specification

PRODUCT SPECIFICATION

Customer : _____

Product Name : Operational Amplifier

Part NO : FOPA75X

Issue Date : _____

Prepared	Checked	Customer Check
ChenTT	Zelig	

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1. Features

- Supply Voltage: 2.7V to 5.5V
- Low Supply Current: 900 μA per channel
- Rail to Rail Input and Output
- Bandwidth: 10MHz
- Slew Rate: 8V/ μs
- Excellent EMI Suppress Performance
- Offset Voltage: ±3mV Maximum
- Offset Voltage Temperature Drift: 2 μV/℃
- Low Noise: 27nV/ √ Hz at 1kHz
- High Output Capability: 70mA
- -40℃ to 125℃ Operation Temperature Range

2. Applications

- Smoke detectors
- HVAC: heating, ventilating, and air conditioning
- Motor control: AC induction
- Refrigerators
- Wearable devices
- Laptop computers
- Washing machines
- Sensor signal conditioning
- Power modules
- Barcode scanners
- Active Filters
- Low-side current sensing

3. Description

Designed for a broad range of general-purpose signal conditioning tasks, the FOPA75X series offers single, dual, and quad operational amplifier channels. Key features include rail-to-rail input and output (RRIO) capability, a typical quiescent current of 900μA, a unity-gain bandwidth of 10MHz, and a low voltage noise density of 27nV/ √Hz at 1kHz. These attributes make the family well-suited for cost-sensitive yet performance-demanding end equipment. Furthermore, with an ultra-low input bias current of ±1.0pA (typical), the FOPA75X family ensures reliable operation even when interfacing with high-impedance sources up to the megaohm level.

The FOPA75X family incorporates a range of robust features that simplify system-level design. These include unity-gain stability when driving capacitive loads up to 100pF, an integrated RF/EMI suppression filter, immunity to output phase reversal under input overdrive conditions, and built-in electrostatic discharge (ESD) protection rated at 4kV HBM. This combination ensures reliable and user-friendly operation across diverse applications.

The FOPA75X devices are designed to support a wide supply range from as low as 2.7V (±1.35V) up to 5.5V (±2.75V). Their performance is fully guaranteed across the extended industrial temperature range of -40℃ to +125℃, ensuring reliable operation in demanding thermal environments.

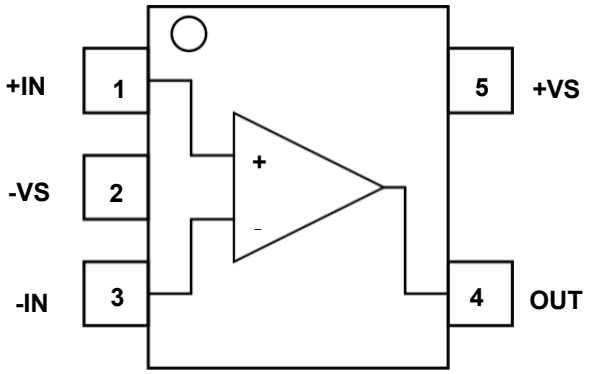
The FOPA751SC (single-channel version) is housed in a 5-lead SC70 package. For dual-channel applications, the FOPA752 is offered in both SOP-8 and MSOP-8 options, while the quad-channel FOPA755T is available in a TSSOP-14 package.

Device Information

Part Number	Package	Description
FOPA751SC	SC70-5	2mmx1.25mm
FOPA752S	SOP-8	6mmx4.9mm
FOPA752M	MSOP-8	5.15mmx3.2mm
FOPA755T	TSSOP-14	6.4mmx5mm

4. Pin Configuration and Functions

5 Pin Functions: FOPA751SC

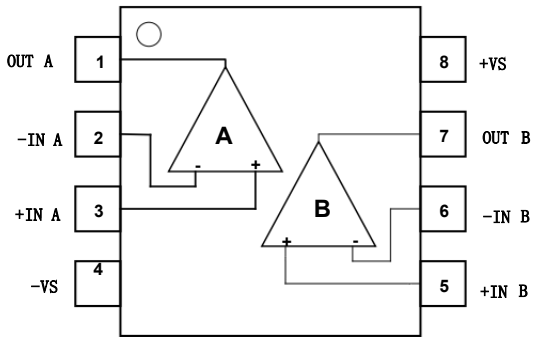


FOPA751SC
SC70-5, Top View

Table 1. Pin Functions: FOPA751SC

PINS		I/O	Description
NAME	No.		
IN+	1	I	Non inverting Input
-VS	2	--	Negative Supply Voltage
IN-	3	I	Inverting Input
OUT	4	O	Output
+VS	5	--	Positive Supply Voltage

8 Pin Functions: FOPA752

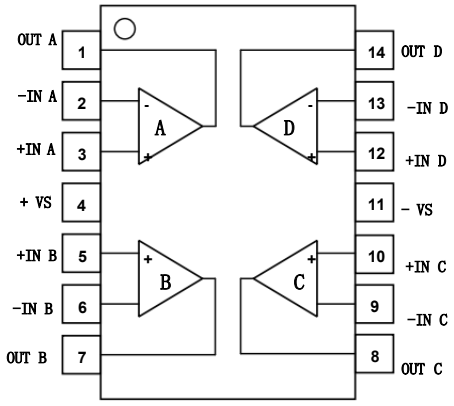


FOPA752
SOP-8/MSOP8 Top View

Table 2. Pin Functions: FOPA752

PINS		I/O	Description
NAME	NO.		
OUTA	1	O	Output, Channel A
-IN A	2	I	Inverting Input, Channel A
+IN A	3	I	Non inverting Input, Channel A
-VS	4	__	Negative Supply Voltage
+IN B	5	I	Non inverting Input, Channel B
-IN B	6	I	Inverting Input, Channel B
OUT B	7	O	Output, channel B
+VS	8	__	Positive Supply Voltage

14 Pin Functions: FOPA755T

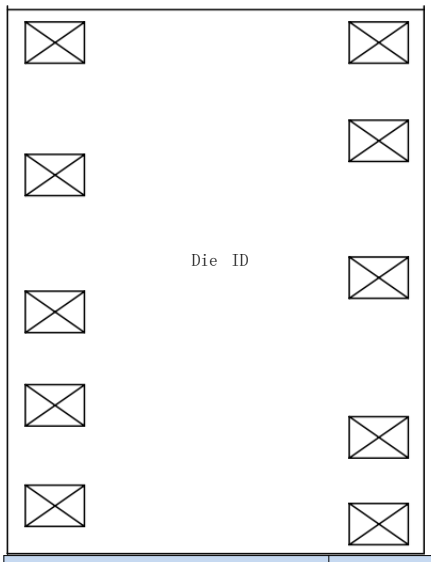


FOPA755T
TSSOP-14, Top View

Table 3. Pin Functions: FOPA755T

PINS		I/O	Description
NAME	NO.		
OUTA	1	O	Output, Channel A
-IN A	2	I	Inverting Input, Channel A
+IN A	3	I	Non inverting Input, Channel A
+VS	4	__	Positive Supply Voltage
+IN B	5	I	Non inverting Input, Channel B
-IN B	6	I	Inverting Input, Channel B
OUT B	7	O	Output, channel B
OUT C	8	O	Output, channel C
- IN C	9	I	Inverting input, channel C
+IN C	10	I	Non inverting input, channel C
- VS	11	__	Negative Supply Voltage
+IN D	12	I	Non inverting input, channel D
-IN D	13	I	Inverting input, channel D
OUT D	14	O	Output, channel D

5. PAD Configuration



Pad Name	X Coordinate	Y Coordinate	Spot Length	Spot Width
NC1	-201.90	254.16	80	60
NC2	201.90	254.16	80	60
VDD	201.90	169.67	80	60
OUT1	-201.90	62.47	80	60
OUT2	201.90	-37.93	80	60
INN1	-201.90	-72.19	80	60
INP1	-201.90	-148.19	80	60
INN2	201.90	-172.08	80	60
VSS	-201.90	-234.34	80	60
INP2	201.90	-248.08	80	60

Note: Substrate is connected to GND or floating.

Die Size: 550 um* 640 um (Not include scribe line), scribe line: 60um*60um

Pad Size: 80um*60um **Substrate Level:** GND or Floating

6. PAD Description

Pin Name	Type	Pin Name
OUTA	Output	Output, Channel A
-IN A	Input	Inverting Input, Channel A
+IN A	Input	Non inverting Input, Channel A
-VS	Power	Negative Supply Voltage
+IN B	Input	Non inverting Input, Channel B
-IN B	Input	Inverting Input, Channel B
OUT B	O	Output, channel B
+VS	Power	Positive Supply Voltage

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7. Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
Supply Voltage			7	V
Input Voltage		(V_) _ 0.3	(V+) + 0.3	V
Input Current: +IN, _IN (2)			±10	mA
Differential Input Voltage		(V_) _ (V+)	(V+) _ (V_)	mV
Output Short-Circuit Duration (3)			Indefinite	
T_J	Maximum Junction Temperature		150	° C
T_A	Operating Temperature Range	_40	125	° C
T_{STG}	Storage Temperature Range	_65	150	° C
T_L	Lead Temperature (Soldering 10 sec)		260	° C

(1) Operating conditions exceeding the limits specified in the Absolute Maximum Ratings table may result in permanent damage to the device. Prolonged exposure to any of these extreme conditions can degrade long-term reliability and reduce operational lifetime

(2) Internal ESD protection diodes are connected between the input terminals and each supply rail. To prevent excessive current flow, it is recommended that the input voltage be clamped such that it does not exceed the supply voltage by more than 500mV; under these conditions, the input current should be constrained to no more than 10mA.

(3) Depending on the operating conditions, an external heat sink may be necessary to maintain the junction temperature within the absolute maximum rating. Key factors include the supply voltage level and the number of output channels experiencing short-circuit conditions. The thermal resistance is strongly influenced by the extent of copper area connected to the package pins; the specified values in the datasheet assume minimal trace lengths and copper coverage.

8. ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 (1)	4000	V
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 (2)	1000	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

9. Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOP-8	158	43	° C/W
MSOP-8	210	45	° C/W
TSSOP-14	180	35	° C/W

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10. Electrical Characteristics

All test conditions: V_S = 5 V, R_L = 10 K, V_{CM} = V_{DD}/2, T_A = +27° C, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
V_S	Supply Voltage Range		2.7		5.5	V
I_Q	Quiescent Current per Amplifier			0.9	1.4	mA
PSRR	Power Supply Rejection Ratio		70	90		dB
Input Characteristics						
V_{OS}	Input Offset Voltage	V_{CM} = 0V to 3V	-3	0.5	3	mV
V_{OS} TC	Input Offset Voltage Drift	T_A = -40° C to 125° C		2		μV/° C
I_B	Input Bias Current	T_A = 25° C		1		pA
		T_A = 85° C		50		pA
I_{OS}	Input Offset Current			1		pA
C_{IN}	Input Capacitance	Differential Mode		8		pF
		Common Mode		6.5		pF
Av	Open-loop Voltage Gain	R_{LOAD} = 10kΩ	85	110		dB
V_{CMR}	Common-mode Input Voltage Range		(V-) - 0.1		(V+) +0.1	V
CMRR	Common Mode Rejection Ratio	V_{CM} = 0V to 3V	70	100		dB
Xtalk	Channel Separation	f = 1kHz, R_L = 2kΩ		110		dB
Output Characteristics						
V_{OH}, V_{OL}	Maximum Output Voltage Swing	R_{LOAD} = 10kΩ	-5	5	15	mV
I_{SC}	Output Short-Circuit Current			70		mA
AC Specifications						
GBW	Gain-Bandwidth Product			10		MHz
SR	Slew Rate	Av = 1, V_{OUT} =1.5V to 3.5V, R_{LOAD} = 10kΩ		8		V/μs
ts	Settling Time, 0.1%	Av = 1, 2 V Step, C_{LOAD} = 10pF, R_{LOAD} = 10kΩ		2.7		μs
	Settling Time, 0.01%			4.8		μs
PM	Phase Margin	R_{LOAD} = 10kΩ		70		°
GM	Gain Margin	R_{LOAD} = 10kΩ		15		dB
Noise Performance						
E_N	Input Voltage Noise	f = 0.1Hz to 10Hz		8		μV_{PP}
e_N	Input Voltage Noise Density	f = 1kHz		27		nV $\sqrt{HZ}$
i_N	Input Current Noise	f = 1kHz		2		fA $\sqrt{HZ}$
THD+N	Total Harmonic Distortion and Noise	f = 1kHz, Av = 1, R_L = 2kΩ, V_{OUT} = 1Vp-p		0.003		%

11. Typical Performance Characteristics

V_S = 5 V, V_{CM} = 2.5 V, R_L = 10K, unless otherwise specified.

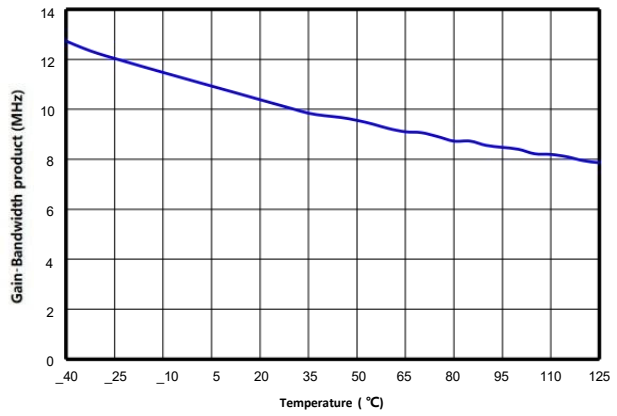


Figure 1. Unity Gain Bandwidth vs. Temperature

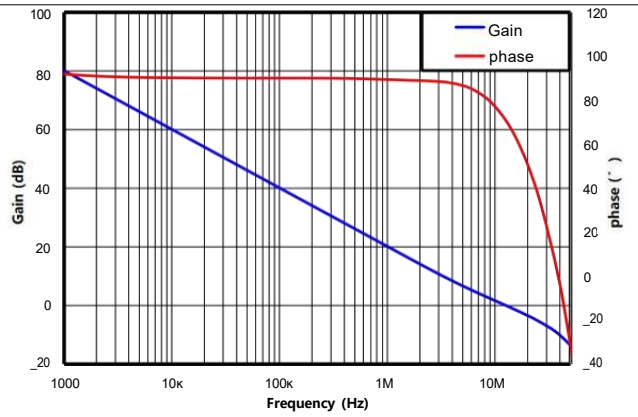


Figure 2. Open-Loop Gain and Phase

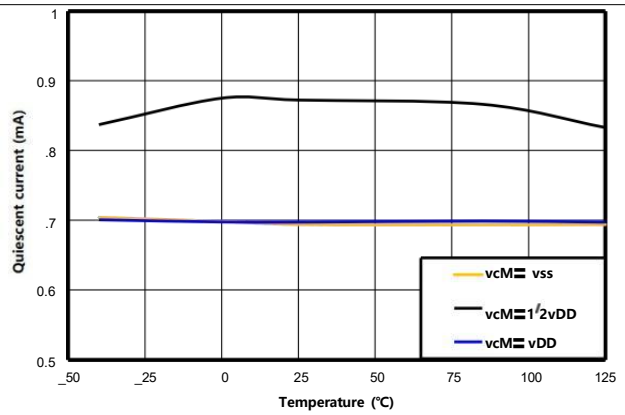


Figure 3. Supply Current vs. Temperature

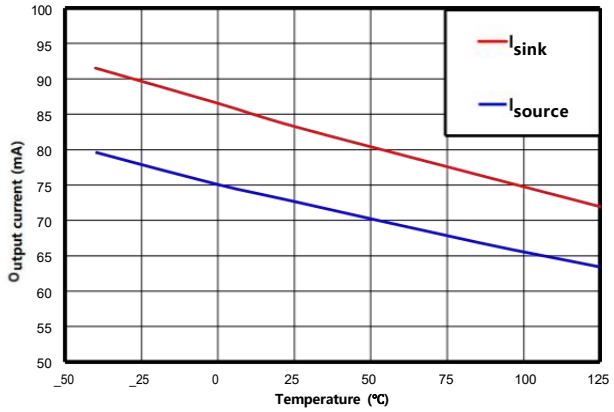


Figure 4. Short Circuit Current vs. Temperature

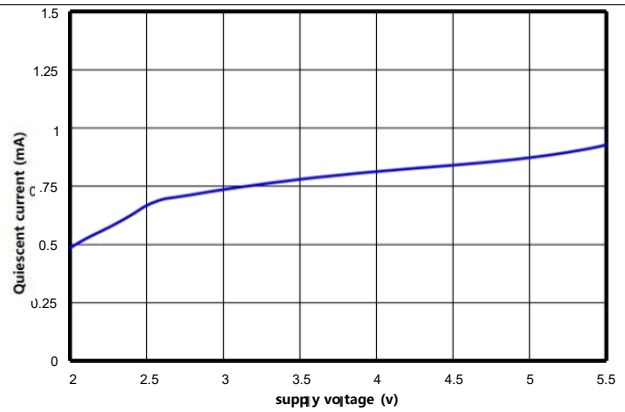


Figure 5. Quiescent Current vs. Supply Voltage

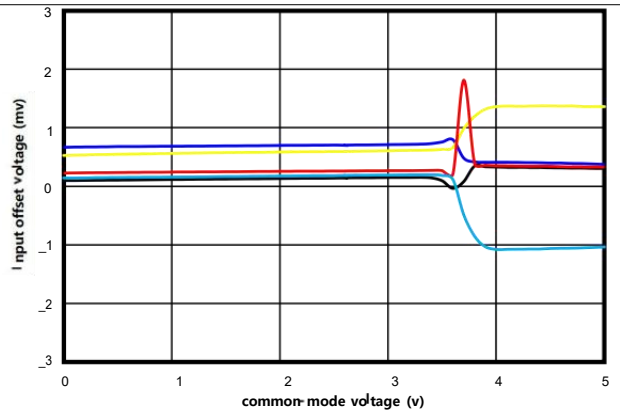


Figure 6. Offset Voltage vs. Common-Mode Voltage

Typical Performance Characteristics (Continued)

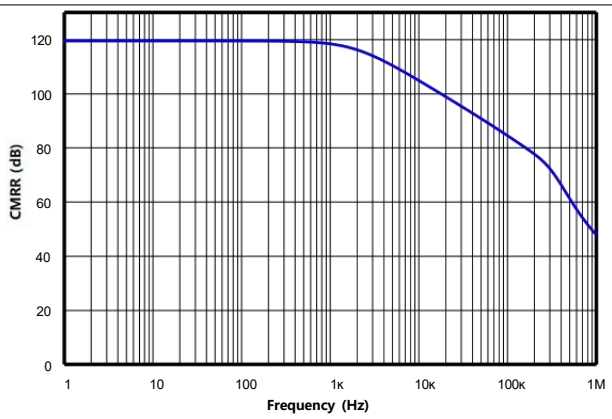


Figure 7. CMRR vs. Frequency

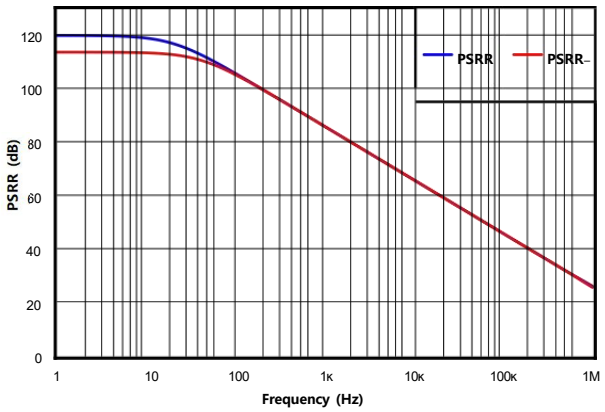


Figure 8. PSRR vs. Frequency

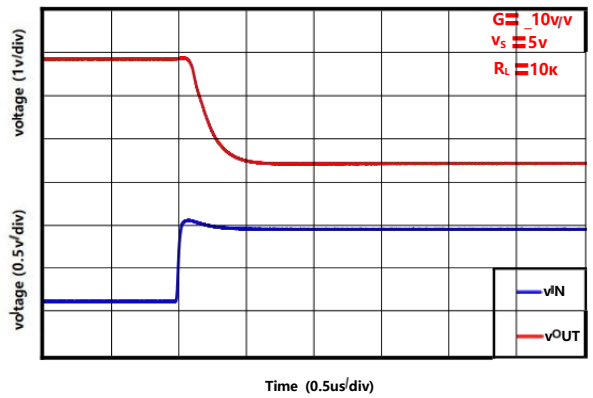


Figure 9. Positive Over-Voltage Recovery

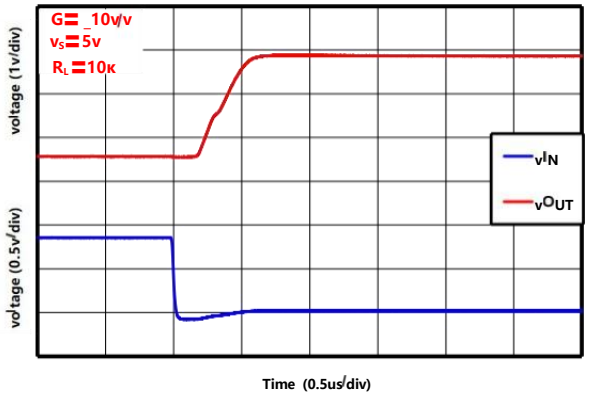


Figure 10. Negative Over-Voltage Recovery

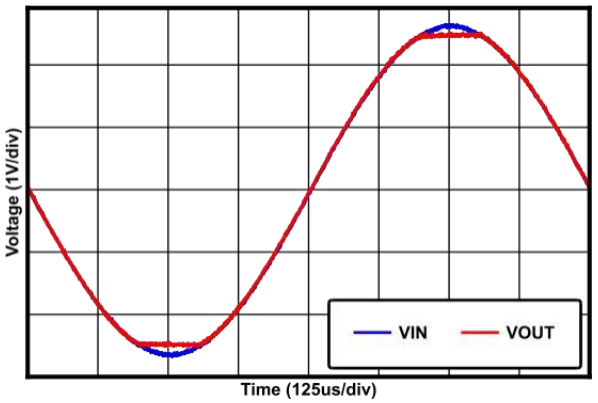


Figure 11. No Phase Reversal

12. Application Information

12.1 Low Supply Voltage and Low Power Consumption

The FOPA75X series is designed to operate from a 2.7V to 5.5V supply, consuming only 900μA of quiescent current per channel. This low-power, low-voltage profile makes the family particularly suitable for battery-powered and portable equipment where high capacitive-load drive capability and stable wideband response are essential. With an optimized gain-bandwidth product (GBWP) relative to power consumption, the FOPA75X delivers one of the best efficiency figures in its class. The devices remain stable at unity gain regardless of the capacitive load. As load capacitance increases, the non-dominant pole of the open-loop response moves toward lower frequencies, which reduces phase and gain margins. In practice, higher closed-loop gains improve capacitive-load performance compared with unity-gain configurations, since the reduced closed-loop bandwidth results in increased phase margin.

12.2 Ground Sensing and Rail to Rail Output

The FOPA75X family delivers robust output drive capability, with each amplifier capable of sourcing or sinking more than 70mA of output current. The rail-to-rail output stage permits the output voltage to come within 10mV of either supply rail. On the input side, the common-mode range extends 200mV beyond both supply voltages, enabling true ground-sensing functionality that broadens the device's applicability in single-supply systems. It should be noted that the maximum output current is supply-dependent; higher supply voltages result in increased current-drive capacity. To maintain safe operation under sustained short-circuit conditions, the junction temperature must remain below 150°C to prevent thermal stress or damage. The output circuitry includes reverse-biased ESD protection diodes connected to each supply rail; therefore, the output voltage should not be allowed to exceed the supply rails by more than 0.5V, as doing so may forward-bias these diodes and create undesirable current paths.

12.3 Driving Large Capacitive Load

In feedback configurations employing internal frequency compensation, increased load capacitance reduces the overall phase margin of the loop. As the capacitive load grows, the phase margin continues to diminish, accompanied by a corresponding reduction in closed-loop bandwidth. These effects manifest as gain peaking in the frequency domain, as well as overshoot and ringing in the output transient response. Among all gain settings, the unity-gain buffer configuration (G = +1 V/V) is most susceptible to the effects of large capacitive loads.

When driving large capacitive loads with the FOPA75X OPA family (e.g.,> 200 pF when G = +1 V/V), a small series resistor at the output improves the feedback loop's phase margin and stability by making the output load resistive at higher frequencies.

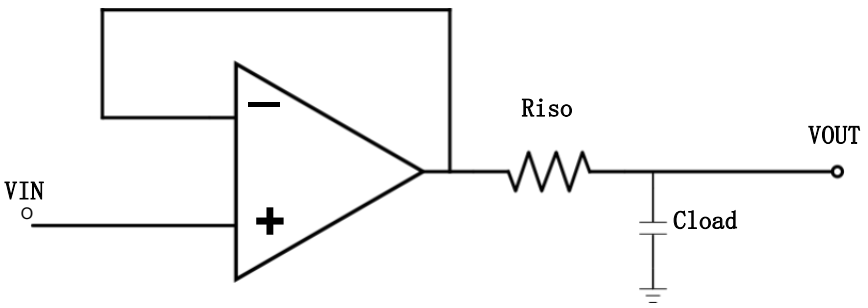
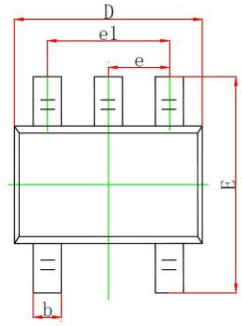


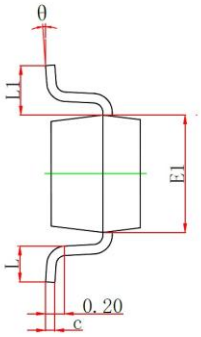
Figure 12. Drive Large Capacitive Load

13. Package Information

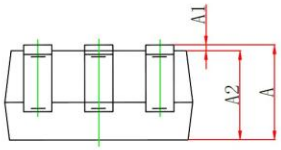
SC70-5



TOP VIEW



SIDE VIEW



SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.175	0.004	0.007
D	2.000	2.200	0.079	0.087
E	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
e	0.650 TYP.		0.026 TYP.	
e1	1.200	1.400	0.047	0.055
L	0.260	0.460	0.010	0.018
L1	0.525 REF.		0.021 REF.	
θ	0°	8°	0°	8°

Note:
1.All dimensions are in mm. Angels in degrees.
2.Refer Jedec MO-178
3.Dimensions exclude burrs, mold flash or protrusions.

SC70-5L (C05) POD Rev.0

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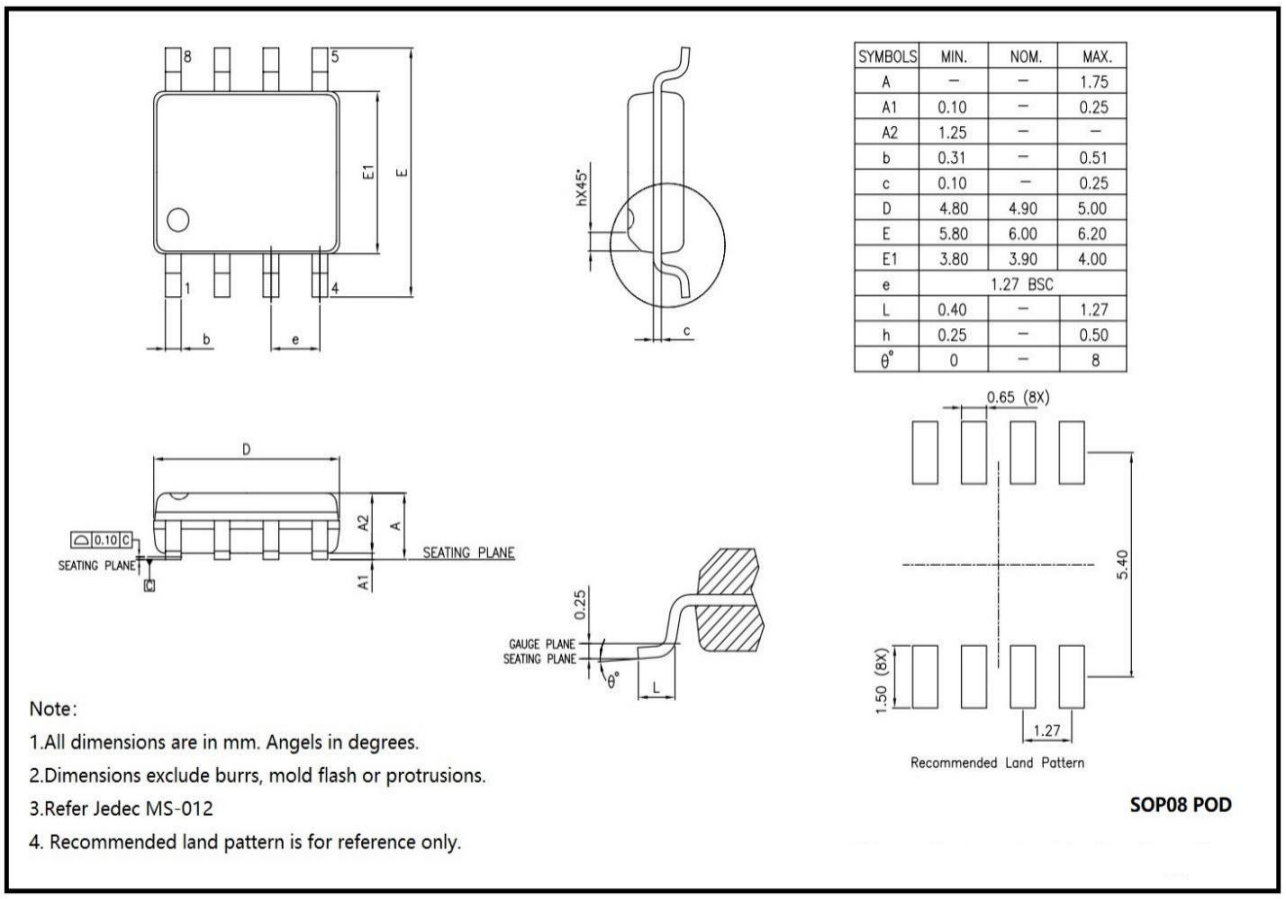
SOP-8



SYMBOLS	MIN.	NOM.	MAX.
A	–	–	1.75
A1	0.10	–	0.25
A2	1.25	–	–
b	0.31	–	0.51
c	0.10	–	0.25
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.40	–	1.27
h	0.25	–	0.50
θ°	0	–	8

Note:

1.All dimensions are in mm. Angels in degrees.

2.Dimensions exclude burrs, mold flash or protrusions.

3.Refer Jedec MS-012

4. Recommended land pattern is for reference only.

SOP08 POD

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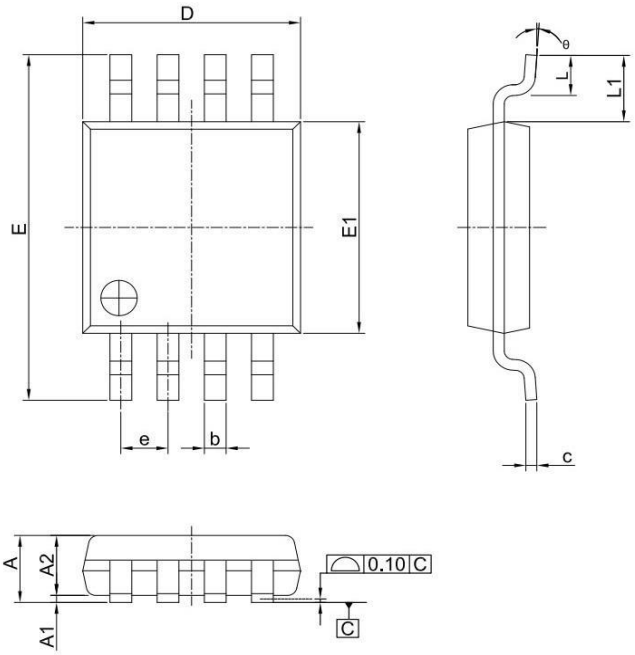
MSOP-8



PKG DIMENSIONS(MM)		
SYMBOL	Min.	Max.
A	--	1.10
A1	0.00	0.15
A2	0.75	0.95
b	0.22	0.38
c	0.08	0.23
D	2.80	3.20
E	4.65	5.15
E1	2.80	3.20
e	0.65 BSC	
L	0.40	0.80
L1	0.95 REF	
θ	0°	8°

Note:

1.All dimensions are in mm. Angels in degrees.

2.Refer Jedec MO-187

3.Dimensions exclude burrs, mold flash or protrusions.

MSOP08 POD Rev.0

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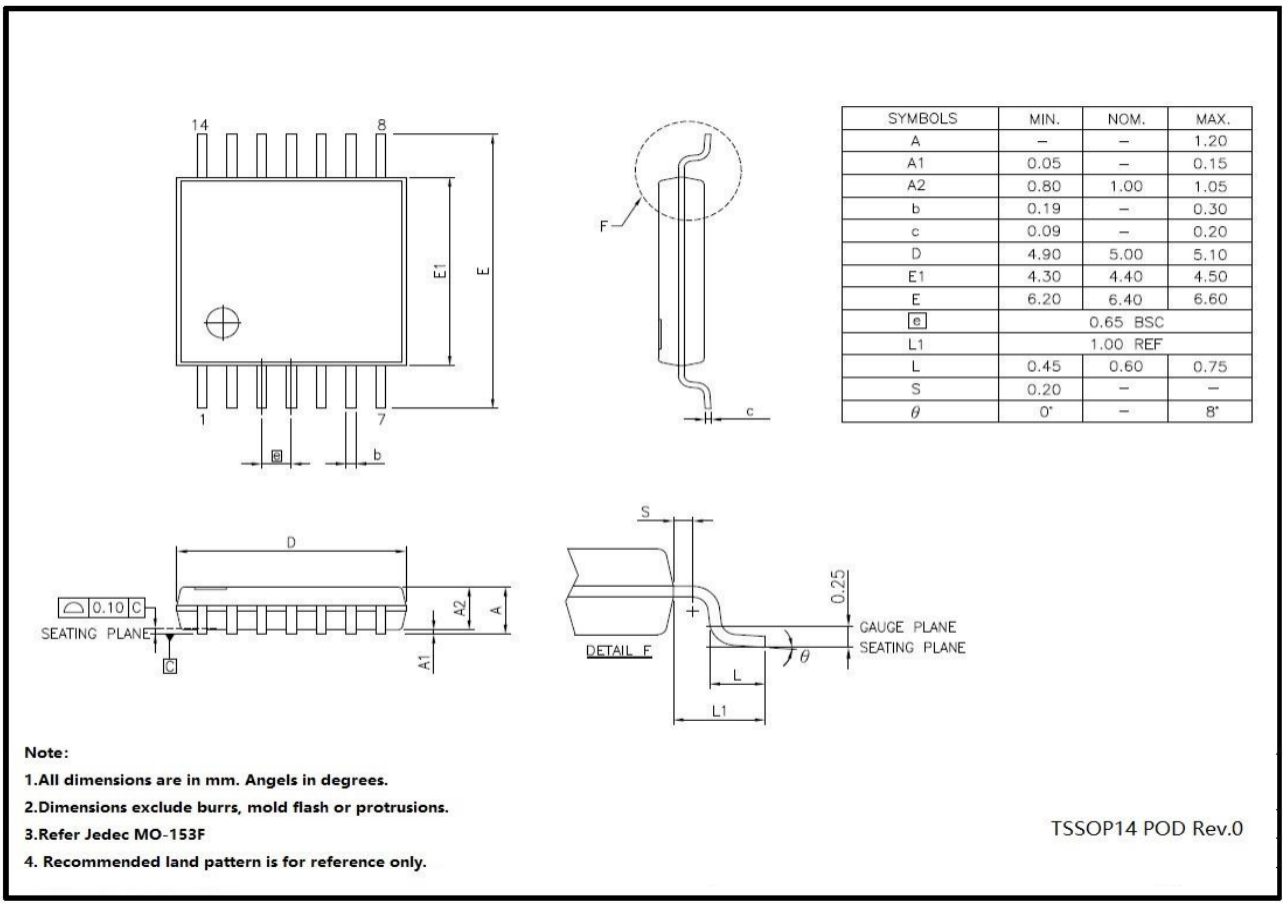
TSSOP-14



SYMBOLS	MIN.	NOM.	MAX.
A	–	–	1.20
A1	0.05	–	0.15
A2	0.80	1.00	1.05
b	0.19	–	0.30
c	0.09	–	0.20
D	4.90	5.00	5.10
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65 BSC		
L1	1.00 REF		
L	0.45	0.60	0.75
S	0.20	–	–
θ	0°	–	8°

Note:

1.All dimensions are in mm. Angels in degrees.

2.Dimensions exclude burrs, mold flash or protrusions.

3.Refer Jedec MO-153F

4. Recommended land pattern is for reference only.

TSSOP14 POD Rev.0